PATENT SPECIFICATION

DRAWINGS ATTACHED

830,094

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COMPLETE SPECIFICATION

Yoke for a Magnetic Circuit and method of Producing Same

We, AKTIENGESELLSCHAFT BROWN BOVERI & CIE., of Baden, Switzerland, a Swiss Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Magnetic circuits, particularly for transformers and reactors, are generally composed of a core for carrying the electric winding and a yoke, the purpose of which is to close the magnetic circuit. These yokes can be constructed in various ways, particularly in the form of a sheet metal band which is wound around a mandrel having a shape which takes into account the assembly with the core parts. Generally the core and yoke are built together by either interleaving the core sheets with the yoke sheets or means are provided in order to fill any gaps which occur, or by means of abutting core and yoke sheets which with holding means for the whole magnetic circuit give the structure sufficient strength.

In the last-mentioned case bolts located outside the magnetic circuit have been used in a known manner in order to hold the magnetic circuit together, whereby the complete structure becomes somewhat complicated. Bolts have also been used which are located centrally in the core and extend through an annular intermediate space provided in the yoke. The yoke then consists of two concentric rings, this being magnetically a disadvantage as regards the arrangement of the cores. In connection with an annular yoke with three cores it has been proposed to fix each core to the associated yoke parts by means of a clamp, this being however a disadvantage as regards cylindrical cores.

The present invention comprising the production of a one-part yoke which is formed by winding a sheet metal band around a suitable mandrel, the method for the fabrication being characterised by the following steps:—

a) The metal band is subjected to such a tension during winding that each turn is kept under pressure by the next turn, whereby the yoke acquires a great strength which approaches that of a homogeneous body and either holes are bored through it parallel to the surface of the metal sheet without destroying it and thus causing additional electrical losses, and whereby said holes accommodate bolts for holding together the magnetic circuit, or holes are formed by the winding process itself;

b) after the winding process the free ends of the sheets are fixed internally and externally to the yoke, for instance by spot welding;

c) after the foregoing operations have been performed, the yoke is annealed at a temperature of about 700° C. or more.

The invention also comprises yokes fabricated in accordance with the method described in the preceding paragraph especially for transformers, reactors and similar apparatus, which consist of a wound sheet metal band and are characterised by the feature that the yoke bodies have holes drilled through them parallel to the sheet surface which serve to accommodate the bolts for fixing the yoke, whereby the yoke body which is annealed after working is like a homogeneous body and has almost the strength of the latter.

The purpose of the aforementioned annealing at a temperature preferably above 700° C. is on the one hand to eliminate the stress due to the elasticity of the metal sheets and on the other hand to restore the magnetic properties to the sheet metal material which it had before it was worked.

In order that the annealing process should not cause any damage to the insulation of the sheets, this insulation must consist of a material which can withstand the annealing temperature.

This annealing process after the working process is particularly advantageous when magnetic sheets with a definite crystal orientation are used. After annealing, no further work-

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Price 4s 6d

ing which would disturb the magnetic properties of these very sensitive sheets is necessary until the magnetic circuit is assembled.

Constructional examples of the invention are now explained with the aid of the accompanying drawing. They refer, without restricting the invention to these forms, to a toroidal and triangular shaped yoke as shown in Figures 1 and 2 respectively for three-phase transformers with three cores, and in Figure 3 to an elliptical yoke for a single-phase transformer with two cores.

Figures 1 to 3 show the yokes in plan view.

Figure 4 shows a yoke construction in elevation for very large dimensions, whilst Figures 5 and 6 show cross-sectional views of yokes which differ from the rectangular shape.

Referring to the drawings a yoke 1 consisting as described above of a wound metal band can when intended for three-phase transformers be of circular or toroidal shape as shown in Figure 1 or triangular shape according to Figure 2 and has for instance three holes 2, 3, 4 which penetrate the yoke body in a direction parallel to the surface of the sheets. These holes are intended for the bolts which hold the yokes and cores together so as to form the magnetic circuit. These holes are preferably located on the centre line of the yoke and mutually displaced by 120° in the cores shown. In the case according to Figure 2 the holes are located in the corners of the triangular yoke.

In the case of a single-phase transformer the yoke is preferably in the form of an ellipse as shown in Figure 3, the holes 5, 6 required for the bolts serving to hold together the magnetic circuit being arranged on the major axis of the ellipse.

The yokes according to Figures 1 to 3, as already started above, consist of a metal band which is wound under high tension and whose ends are fixed internally and externally at S and S^1 respectively. Only after machining, that is after drilling the holes 2 to 6, is the yoke annealed at a temperature preferably above 700° C.

In such cases where a very high yoke is required, irrespective of the winding form and the transformer type, it can as shown in Figure 4 be provided with an external clamp 7 which gives it greater strength if necessary.

The cross-section of the yoke is usually rectangular. In order to obtain a better distribution of the magnetic flux it is possible to select another cross-sectional shape with an irregular contour. Figures 5 and 6 show such constructional forms.

The step-like cross-section according to Figure 5 can be obtained by providing several individual yokes A, B, C, B^1, A^1 of different height which are mounted one on top of the other, each yoke being fabricated according to the method described. Such a shape can also be obtained by winding a metal band whose width varies.

The cross-section D shown in Figure 6 which is composed of trapezes is obtained by winding a sheet whose width varies continuously between a minimum and a maximum value.

Other cross-sectional shapes than these described can be chosen and obtained by similar means.

WHAT WE CLAIM IS:—

1. Method of fabricating a yoke for a magnetic circuit, particularly for transformers, reactors, and similar apparatus, consisting of a metal band wound uniformly around a suitable mandrel, characterised by the following steps:—

a) The metal band is subjected to such a tension during winding that each turn is kept under pressure by the next turn, whereby the yoke acquires a great strength which approaches that of a homogeneous body and either holes are bored through it parallel to the surface of the metal sheet without destroying it and thus causing additional electrical losses, and whereby said holes accommodate bolts for holding together the magnetic circuit, or holes are formed by the winding process itself;

b) at the end of the winding process the ends of the metal band are fixed internally and externally to the yoke;

c) after the foregoing steps the yoke is annealed at a temperature of about 700° C. or more.

2. A yoke fabricated according to the method of Claim 1, consisting of a wound metal band, characterised by the feature that the yoke body has holes that are drilled parallel to the sheet surface and which serve to accommodate bolts for fixing the yoke.

3. Yoke as in Claim 2 for three-phase transformers, characterised by a yoke body wound in the form of a triangle and which has holes in the corners for fixing the yoke.

4. Yoke as in Claim 2, characterised by the feature that the yoke body consisting of wound sheet metal is held by a clamp which gives it additional strength.

5. Yoke as in Claim 2, characterised by the feature that the cross-sectional form of the yoke body is other than rectangular shape.

6. Methods of producing yokes in accordance with Claim 1, for magnetic circuits substantially as described.

7. Yokes for magnetic circuits, substantially as described with reference to the accompanying diagrammatic drawings.

MARKS & CLERK.

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830,094 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig. 1

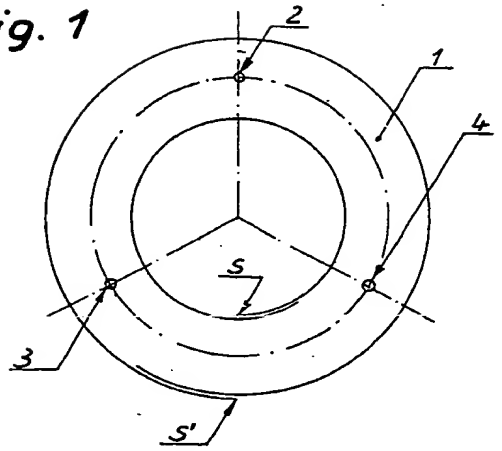

Fig. 4

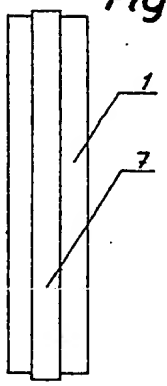

Fig. 2

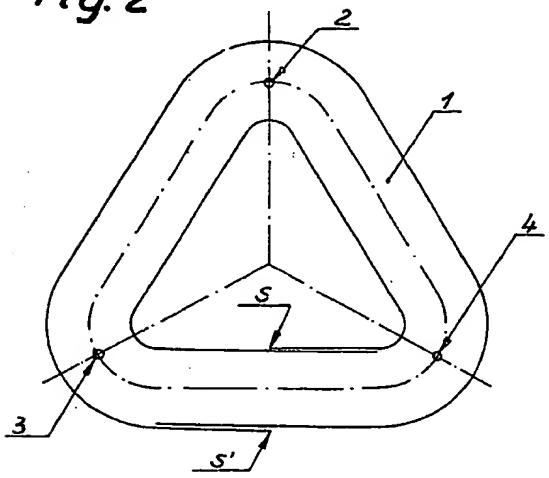

Fig. 5

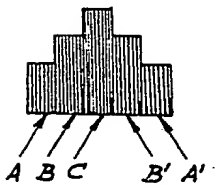

Fig. 3

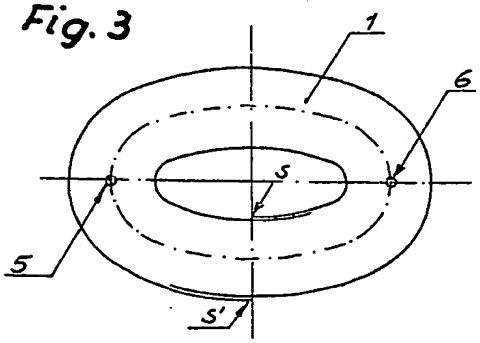

Fig. 6